CLAIMS

What is claimed is:

1.   A system for saving power in a wireless network, comprising:

an access point having a priority queue;

one or more stations;

an SIV frame comprising:

   one or more schedules of wake-up times, corresponding to the one or more stations; and

an algorithm for calculating the transmission time of downlink data for the stations,

   wherein the access point originates and transmits to the one or more stations the SIV frame of the scheduled wake-up times having a transmission order based on the transmission time calculation stored within the priority queue of the access point, and wherein the one or more stations selectively awake from a sleep mode for data transmission therewith based on the schedule.

2.   The system of claim 1, wherein the SIV frame comprises:

a schedule field comprising one or more schedules for scheduling the next wake-up time of one or more stations, based on one of an offset relative to a last beacon or a next beacon, and an offset relative to the current SIV frame; and

   wherein the one or more stations are directed to uplink or downlink CF data, thereby minimizing time the station must remain awake, saving power while minimizing channel contention.

3.   The system of claim 2, wherein the SIV frame further comprises an AID field to numerate the one or more association IDs of the one or more stations for identifying one or more of the stations.

4.   The system of claim 3, wherein the SIV frame further comprises an N_{SIV} field to denote the number of stations scheduled in the current frame, wherein the number of association IDs contained in the AID field.

5.   The system of claim 4, wherein the SIV frame further comprises a listening window field to denote the time period following the scheduled wake-up time, during which the AP should send network traffic.

6.   The system of claim 1, wherein the SIV frame is transmitted to the stations within a TIM frame of a beacon.

7.   The system of claim 1, wherein the access point is configured to generate a TSPEC element comprising a PS interval for specifying a timing offset relative to the current transmission.

8.   The system of claim 1, wherein the access point is further operable to dynamically adjust one or more of the scheduled wake-up times of the stations, a sequence of wake-up times, a periodic wake-up time, a plurality of wake-up times, and a duration of the wake-up times of the stations, based on one or more of network traffic, traffic buffering time, data priorities, data length, and data rates.

9.   The system of claim 8, wherein the dynamic adjustments are made by the access point in the fields of the SIV frame.

10.   The system of claim 1, wherein the access point is further operable to unicast the SIV to one station, thereby providing self correction or retransmission of a schedule for an individual station.

11.   The system of claim 1, wherein the access point is further operable unicast an SIV frame to a station to alter one or more of the scheduled wake-up

times of the station in response to errors on the network and to the arrival of higher priority data.

12.   The system of claim 1, further providing an SIV protocol configurable to allow the access point to ignore current scheduling activities and perform scheduling in response to errors on the network and to the arrival of higher priority data.

13.   The system of claim 1, wherein the algorithm for calculating the transmission time of downlink data for the stations is represented by $T=Q*((MAC\_header + PHY\_header) / Transmission\_rate + 2*SIFS\_TIME + ACK\_time) + L / Transmission\_rate$, where T is the total transmission time of the data frames to a PS station, Q is the number of frames, MAC_header is the MAC layer header length, PHY_header is the physical layer header length, Transmission_rate is the transmission rate of the wireless network, SIFS_TIME is the time delay of the interframe space, ACK_time is the time required by the ACK scheme, L is the total MAC payload in bits in the queue.

14.   The system of claim 13, wherein the algorithm is further operable to aggregate together a plurality of short transmissions comprising all currently scheduled data to a PS station before calculating the transmission time.

15.   The system of claim 1, wherein the transmission order stored in the priority queue of the access point is ordered according to a higher priority assignment for the shortest transmission time.

16.   The system of claim 1, wherein the priority queue of the access point is operable to order and enable the shortest transmission time downlink first.

17. The system of claim 16, wherein the priority queue is further operable to order subsequent transmissions based on which transmission has the shortest transmission time.

18. A method of saving power in a wireless network comprising an access point, one or more stations, an SIV frame, and an algorithm for calculating a transmission time of downlink data for the stations the method comprising:

calculating the transmission time of data to be downlinked to the stations using the algorithm;

determining a priority queue ordering of the transmissions based on the transmission time calculated for each station; and

scheduling an awakening time in the SIV frame for each station based on the transmission order from the transmission time calculations.

19. The method of claim 18, further comprising:

awaking a station from a sleep mode to monitor a beacon from the access point;

determining whether the station's association ID is indicated in the beacon;

returning the station to the sleep mode if the station's association ID is not indicated;

transferring the SIV frame containing schedule data to the station; and

returning the station to the sleep mode and awakening the station for data transmission therewith based on the schedule data.

20. The method of claim 19, further comprising:

determining whether uplink data is to be transmitted from the station to the access point if the station's association ID is indicated in the beacon; and

keeping the station awake; and

sending a CC from the access point to the station and sending an RR back from the station to the access point prior to receiving the SIV.

21. The method of claim 20, wherein returning the station to sleep mode comprising returning the station to sleep mode after receipt of the SIV, and maintaining the station in sleep mode until the schedule data dictates that the station awaken.

22. The method of claim 19, further comprising:

determining whether downlink data is to be transmitted from the access point to the station if the station's association ID is indicated in the beacon; and

keeping the station awake until SIV frame containing schedule data is received.

23. The method of claim 22, further comprising returning the station to sleep mode after receipt of the SIV frame, and maintaining the station in sleep mode until the schedule data dictates that the station awaken.

24. The method of claim 19, wherein awaking the station to monitor a beacon from the access point, comprises awaking the station at a periodic time to monitor a beacon from the access point.

25. The method of claim 19, wherein determining whether a station's association ID is indicated, comprises determining whether a stations association ID is indicated within a TIM of the beacon.

26. The method of claim 19, further comprising modifying the schedule data within a subsequent SIV frame based on one or more of network traffic, traffic buffering time, data priorities, data lengths and data rates.

27.   The method of claim 19, further comprising:

determining whether new power save traffic frames have arrived at the access point before all the SIV frames have been scheduled;

marking the new power save traffic frames;

sending out the SIV frames containing the schedule data;

clearing a MORE_DATA field in the last packet before the mark;

stopping serving the priority queue when the mark has arrived;

allowing the station to go into sleep mode;

disabling the transmissions from the present priority queue; and

buffering further SIV frames until the next beacon.

28.   The method of claim 19, further comprising:

determining whether new power save traffic frames have arrived at the access point before all the SIV frames have been scheduled;

sending out the SIV frames containing the schedule data;

clearing a MORE_DATA field in the last packet of the priority queue;

allowing the station to go into sleep mode; and

disabling further transmissions from the priority queue until the next beacon.

29.   The method of claim 19, further comprising:

determining from the SIV frame received by a station whether the time remaining until the scheduled wake-up time S_i is less than a pre-wakeup guard time Δ;

decoding the SIV frame on the wireless channel if the time remaining until the scheduled wake-up time S_i is less than a pre-wakeup guard time Δ; and

sleeping until the scheduled wake-up time S_i less the pre-wakeup guard time Δ ($S_i - \Delta$) and decoding the SIV frame on the wireless channel if the time remaining until the scheduled wake-up time is greater than the pre-wakeup guard time Δ.

30.   The method of claim 29, further comprising:

determining whether the AID in an SIV frame matches that of a station's and whether the MORE_DATA bit is set to zero;

allowing the station to go back to sleep mode until the next beacon if the AID matches and the MORE_DATA bit is set to zero; and

remaining awake to decode further SIV frames if either the AID does not match or the MORE_DATA bit is not set to zero.